CHIROPSALMUS MACULATUS SP. NOV., A CUBOMEDUSA FROM THE GREAT BARRIER REEF

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A large cubomedusa, *Chiropsalmus maculatus* sp. nov., is described from the only known specimen, observed and collected live near the outer edge of the Great Barrier Reef. It is distinctive in lacking a 'palm' to what is a palmate, compound pedalium in other known chirodropids, and in having conspicuous, deeply corrugated subumbrellar muscle-fields. It is unique among known cubomedusae in having a pigmented exumbrellar epidermis. Much of the surface was covered in life by more than 40 discrete, sub-circular, patches of colour, and the base of each pedalium was encircled by a fine line of pigment. Some of the patches were arranged in a loose pattern, and there was a regular circle of unpigmented epidermis surrounding each rhopalium, both suggesting strongly that the coloration was genotypic and not due to a pathogen or other cause external to the animal. ☐ *Cnidaria, cubomedusae, chirodropids, venomous, box jellyfish, Great Barrier Reef.*

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A single cubomedusa was collected in May 1997, in latitude 16° S, some 40 km off the coast of NE Queensland, near the outer edge of the Great Barrier Reef. The specimen was c. 150 mm high, and its bell was conspicuously spotted with brown patches, whereas other known cubomedusae almost entirely lack bell coloration. It is described here as *Chiropsalmus maculatus* sp. nov. (Fig. 1). The area attracts much attention from divers and snorkellers. Many of them will be aware of the extremely venomous *Chironex fleckeri* Southcott, 1956, endemic in the region and similar in general appearance to the species described here. Since the new species has not been reported before it may be genuinely rare in the area. Its occurrence may be related to the passage through the area a few weeks earlier of Cyclone Justin, following which a teleost fish (*Lethrinus*), typically found off the continental shelf, occurred in coastal waters, suggesting a similar deepwater origin of the newly described medusa. Although just one specimen is known, its features are so distinctive that its recognition as previously undescribed is justified.

MATERIALS AND METHODS

We were reluctant to dissect the unique specimen. In fact, within two years in formaldehyde solution it had become so stiff and brittle that further detailed study might have damaged it in ways unnecessary to provisionally define the species. Detailed study of rhopalia, velarial canals, sinuses, nematocysts and some other features will best await further specimens.

The word pedalium is applied in cubomedusan literature to two dissimilar structures. In one of the two generally recognised cubomedusan families, the Carybdeidae, at the base of each tentacle is a thickened or otherwise demarcated region termed the pedalium. Such pedalia are inserted in four groups, one at each lower corner of the bell, but each individual pedalium is there attached directly to the lower edge of the bell. In the Chirodropidae, however, the tentacles on each corner are inserted essentially around the edge of (in most species) a palm-shaped structure which has also been termed a pedalium. In the present account, a distinction is made where necessary by use of the terms individual pedalium for the first and compound pedalium for the second. Other terminology follows Williamson et al. (1996) and Mianzan & Cornelius (1999) which included a glossary.

It is not known if the new species is venomous to Man. However, in view of the extreme virulence of some chirodropids great caution should be exercised with live specimens. The species is one of the larger chirodropids and, if venomous to Man, its large size might well result in massive, harmful envenomation.

FIG. 1. *Chiropsalmus maculatus* sp. nov., drawn from video sequence, photographs of live animal and preserved specimen. Note that the tentacles are partially contracted. The shape of the rhopalial slit in life was invisible in the video sequence of the specimen swimming prior to collection, and distorted in the preserved specimen. The blank rhopalial area, shown, may, therefore, represent the normal appearance in life, but confirmation is needed. Bell height 150 mm.

SYSTEMATICS

Phylum CNIDARIA
Subphylum MEDUSOZOA Petersen
Class CUBOZOA Werner
Order CUBOMEDUSAE Werner
Family CHIRODROPIDAE Haeckel

Chiropsalmus L. Agassiz, 1862

REMARKS. Generic divisions in the Chirodropidae are traditionally based on the form of the gonads and subumbrellar saccules, which at sexual maturity are processes of varied shape hanging down into the subumbrellar space. The saccules are regarded as infertile in *Chiropsalmus* but bear the gonad tissue in the single species assigned to *Chironex*. Since the specimen of the present species had neither gonads nor saccules, generic assignment cannot be made on these features. It is, therefore, referred only provisionally to *Chiropsalmus*. This action is preferred over introduction of a monotypic genus because such a genus might fall when fertile material is found.

At present the Chirodropidae comprises *Chiropsalmus* Agassiz, 1862, *Chirodropus* Haeckel, 1880, and *Chironex* Southcott, 1956, of which the last is considered monotypic. The introduction of monotypic or even small genera, closely resembling previously recognised ones, in any family, needs firm justification based on appropriate distinction. Hence some generic revision may be needed in this family since gonad structure alone has been employed. Some account should be taken of generic divisions in other cubo- and scyphomedusae, because in the latter, at least, intrageneric variation in gonad structure is seldom taken as justification for generic separation. Although we suggest that generic revision among chirodropids might be useful, it is inappropriate in the present account of one specimen.

An unusual constraint on the generic assignment of species in the highly venomous Chirodropidae should be stressed here. The need for easy and rapid access to stored medical data by clinicians urgently treating potentially fatal sting cases should perhaps pragmatically over-ride zoological convention. *Chironex fleckeri* is extremely dangerous to Man, some envenomations causing death within a few minutes (Williamson et al., 1996). It is also a common species along tropical Australian coasts and along those of several tropical countries to the north. Thus it will be useful in information retrieval in an emergency, that the genus name should be retained only for the one so-far known extremely venomous species, *Chironex fleckeri*. Whether or not *Chiropsalmus maculatus* sp. nov. is venomous to Man is unknown. But if it proves harmless, future generic revisers will hopefully agree that regardless of anatomy it should not be referred to *Chironex*. Though one or more *Chiropsalmus* species (depending on taxonomic view) are harmful, they are less so than the one species of *Chironex*, and some are quite harmless. Since *Chironex* can kill in less than five minutes, depending partly on envenomation intensity, the appearance in literature-searching during an emergency of unhelpful references to harmless species might contribute to clinical disaster. The point is emphasised here to forestall over-zealous nomenclatural revision, perhaps materially inhibiting clinical practice.

FIG. 2. *Chiropsalmus maculatus* sp. nov. Single compound-pedalium in side view with associated individual tentacle bases. Length of upper segment of compound pedalium 60 mm.

Chiropsalmus maculatus sp. nov.
(Figs 1-6)

MATERIAL. HOLOTYPE QMG316989: Just inside Outer Barrier Reef, NE Queensland, 43 km off mainland, 15° 59.050'S, 145° 49.294'E, 2 May 1997, within 5m of surface, coll. R. Hore. A 23-second underwater video sequence was taken of the living animal before collection, and is deposited with the type specimen. There was a substantial, permanent, illuminated Man-made structure in the vicinity, but the specimen was noticed in daylight. The specimen could not be fixed for several hours, and subsequently proved notably brittle and fragile.

DESCRIPTION. A solid chirodropid with conspicuous vertical fluted ridges at corners and massive pedalial bases jutting out prominently from lowermost 1/5 of bell (Fig. 1); irregular sub-circular brown patches over most of epidermis, arranged quasi-regularly in lines and in other patterns, but not present in a hyaline circular patch surrounding each rhopalium. Composite pedalia unlike those of *Chironex fleckeri* in not being palmate, the tentacles being inserted contiguously (Fig. 3B,C).

Bell 150 mm high; in life seeming spherical in side view, apex slightly rounded to flat, cuboid in plan view; corners of bell grooved from top to within 15 mm of pedalium, deepest (9 mm) aborally; sides of bell with two further grooves, c. 4 mm deep, straight from within 50 mm of upper edge to level of rhopalium where deflect inwards, passing within 2 mm of rhopalial niche, then extending to velarium but not meeting it. Exumbrellar surface and mesogloea transparent in life, internal structures visible through it where exumbrellar pigment absent. Jelly maximum thickness 10 mm in perradius, 20 mm in interradius; flexible in life but bending only slightly during swimming; firm after preservation in formaldehyde solution.

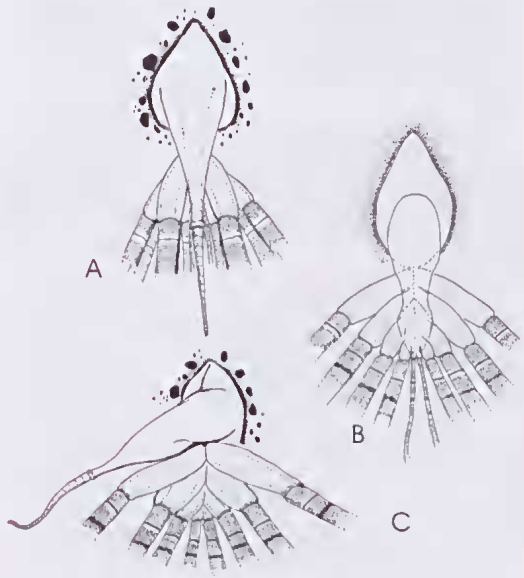

FIG. 3. *Chiropsalmus maculatus* sp. nov. A, B, single compound-pedalium in plan view from outside of specimen. Left upper, A, in natural position. Left lower, B, with the unpaired outer section pulled to reader's left. Right middle, C, same from inside to show contiguous bases of the paired tentacle bases. In C the puny, unpaired outer tentacle is not visible since the view is from the inside; and two small, paired, probably young tentacles are shown in the mid-line.

FIG. 4. *Chiropsalmus maculatus* sp. nov., part of subumbrellar surface of holotype. Note the deeply folded muscle-fields and the gastric cirri. Scale in mm.

Velarium thin; width about 1/4 bell aperture; when extended during bell contraction, slightly tapering below; edge seemingly frilled but even; connected to subumbrellar surface by a frenulum in each of the 4 perradial planes; velarial canals not discerned.

Rhopalial niche large, entrance slit probably shallowly curved in life but shape unclear from specimen and photographic material, 6-9 mm wide, closed and distorted in preserved specimen and apparently closed in video sequence; surrounding epidermis slightly puckered several hours after collection, possibly smooth in life, colourless; lips flush with outer surface; rhopalium (in preserved specimen) totally enclosed within closed niche and not examined.

Pedalia and tentacles. Each compound pedalium (Figs 2, 3) inserted on lowermost 1/5 of bell, its area of attachment inverted heart-shaped, pointed above; slightly tapering distally; symmetrical about mid-line, and without palmate central region as in *Chironex*; comprising a large triangular outer portion bearing single tentacle, and two mirror-image flanking portions apparently fused together in mid-line; outer portion in side view elongate-triangular, projecting conspicuously clear of rest of pedalium, bending slightly (as though hinged) at mid-point of upper surface on each power-stroke of bell; bearing single, narrow, short and puny tentacle, its length in life approximately half bell diameter, and trailing outside main cluster of tentacles; two inner portions each comprising 5-(probably)7 thick, almost cylindrical, pedalial 'fingers', flattened laterally, inserted closely together with opposite and adjacent pedalial bases contiguous or nearly so. Each tentacle moderately thick, hollow, tapering distally; perhaps typically 15 per bell corner (7x2 plus one puny outer) but in present specimen up to 5x2 plus puny outer and also two small presumed tentacle bulbs; outermost one on each compound pedalium unpaired and circular in section, rest paired and flat in section, tapering gradually to point; new tentacles developing from inner side of pedalium.

Subumbrellar surface of bell (Fig. 4) in each inter-rhopalar radius having large field of horizontal muscle-folds, occupying nearly whole height of bell, up to 50 mm across, widest about halfway up bell; about 70 folds in each muscle field. Other, much smaller, vertically-orientated muscle fields near margin of subumbrella.

Gastric system. Manubrium a wide square tube, attached by substantial suspensoria to within 40 mm of mouth; approximately 140 mm long (measured from subumbrella surface) but probably extensile; with convoluted internal surface (this visible from outside) from top to lowest level of suspensoria.

Mouth lips tortuous, slightly thicker than manubrial tissue.

Gastric cirri numerous, up to c. 5 mm long in preserved specimen, finely tapered distally, in conspicuous phacelli (Fig. 4).

Radial and ring sinuses, 'rose-thorn corniculum' not discerned through dimly translucent tissue, even with light behind and after injection of (labile) dye into lumen of one compound pedalial base; but detailed exploration not undertaken owing to fragility and uniqueness of specimen.

Gonads and subumbrellar saccules not identified. Possibly convoluted tissue outside manubrium was gonadial, specimen may be infertile.

Colour and colour pattern. Epidermis with numerous large irregular patches, approximately circular to oval, each c. 10 mm diameter, and numerous scattered, smaller, spots; orange-brown in life, seeming dark chocolate at c. 10 m

FIG. 5. *Chiropsalmus maculatus* sp. nov. Typical banding pattern of a partially contracted main tentacle. Note that variation within the single specimen examined, and intraspecific variation in other chirodropids, suggest that the banding pattern should not be taken as consistent in the species, pending further information.

depth in the sea; some of oval patches twice as long as wide. Several ragged vertical rows of coloured patches per side, those in some rows larger than in others. On each side approximately 24 large patches and 400 of all sizes; c. 35 medium-sized ones clustered in centre of each side; distribution of all spots and larger patches densest towards velarium; remaining spots c. 330 per side, more irregular in outline, some tendency to cluster as 'satellites' of the largest ones. Exumbrellar grooves orange/brown. Elastic tissue of vertical corners of subumbrella reported bright purple before preservation (RH). Compound pedalia colourless, but base of each narrowly rimmed orange-brown. Tentacles (Fig. 5) in life banded purple and white, the bands 1-6 mm wide; losing colour in formaldehyde solution; typically with the narrowest, darkest bands flanked each side by slightly wider pale band (in triplets of light-dark-light), with much longer section of intermediate colour intensity between, but this, the commonest arrangement, inconstant in places; the bands typically identical in position on adjacent tentacles but this uniformity decreasing distally (from video and from photographs of live specimen by R.H.)

DIMENSIONS. Bell height 150 mm (top of bell to base of velarium), maximum width 160 mm. Length of compound pedalium 60 mm. Velarium 27 mm wide. Distance from rhopalar niche to edge of velarium 25 mm; niche height 17 mm, diameter 20 mm. Tentacle diameter up to 10 mm; length extended in life 1.0-1.2 m (from video, maybe longer if completely undisturbed), 300 mm when contracted after preservation in formaldehyde solution. In preserved specimen, the 4 small, outer tentacles (one per pedalial group) 4 mm wide basally, 40 mm long, tapering gradually to point; larger tentacles up to 135 mm long (as contracted in preservative), 10 mm wide basally tapering to 3 mm wide at truncate tip.

STING. No unequivocal information. Following collection the single specimen was kept in sea water in a small bucket at ambient tropical daytime temperature for 5 hrs, after which it failed either to sting, or adhere to, the hand and forearm of an incautious volunteer. This gives no firm indication of its possible virulence, since *C. fleckeri* can lose its capacity to sting in such temperatures (P.J.F.).

REMARKS. In *Chiropsalmus maculatus* sp. nov. the individual tentacles are contiguous basally on the compound pedalium, and there is no 'palm' separating them as in the palmate compound pedalia of other chirodropids. *C. maculatus* sp. nov. differs additionally from *Chironex fleckeri* in having brown spots on the exumbrella and a brown line around the base of each pedalium, the epidermis of *C. fleckeri* and of other large chirodropids being essentially colourless; in the billowing of the bell during swimming, recognised by RH as differing notably from the more rigid appearance of the bell in *C. fleckeri*; and in the coloration of the tentacles (Fig. 5). The general colour pattern of these, of bands of varied width arranged in a semi-regular but varying pattern, recalls that in *Chiropsalmus quadrumanus*. It differs markedly from that in *C. fleckeri*, in which there are typically wide, dark bands separated by narrow, pale bands, there being typically bands of two widths and two colours. In all chirodropids with coloured bands on the tentacles, the contraction of part or all of a tentacle reduces the widths of the bands and distorts the pattern. In the new species the rhopalia are noticeably each surrounded by a clear region devoid of pigment, as though

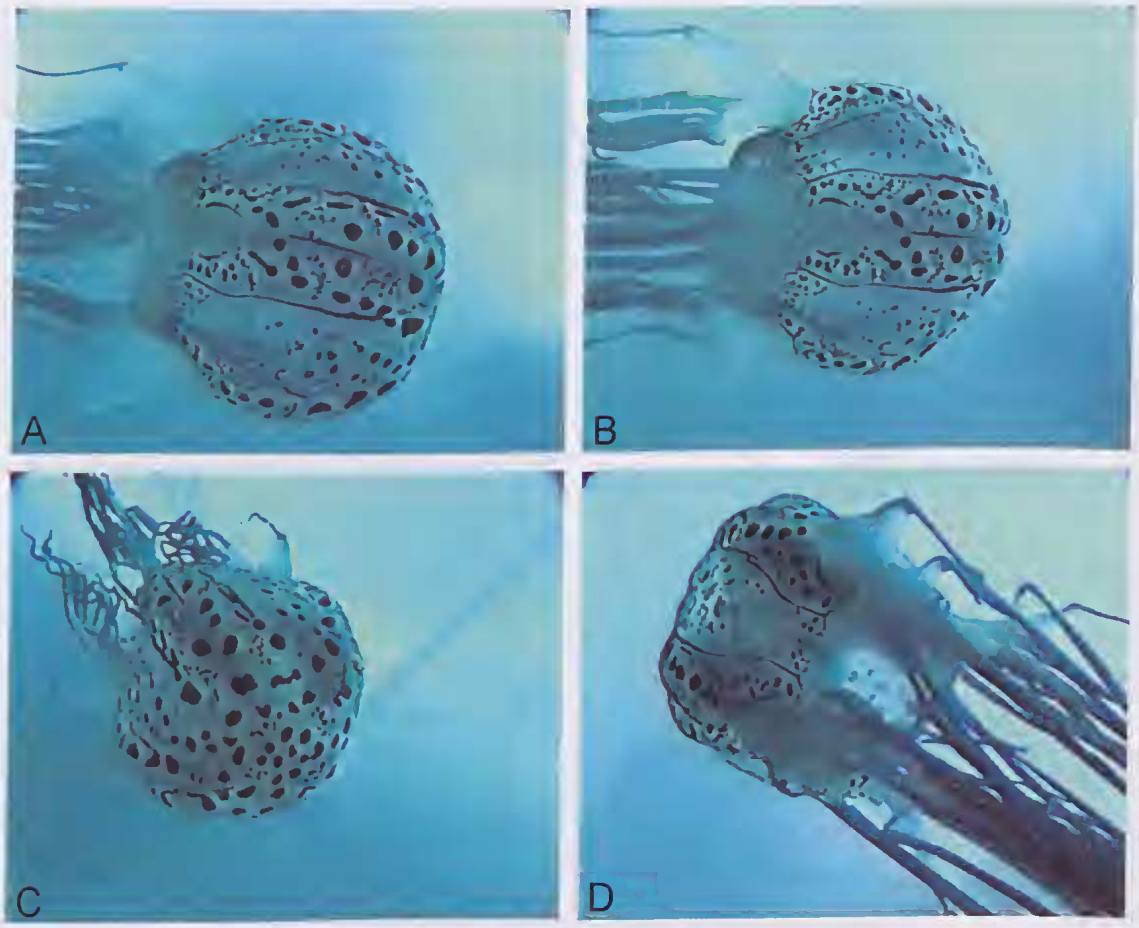

FIG. 6. *Chiropsalmus maculatus* sp. nov. Details of holotype after collection. Stills captured from a DVD sequence prepared from underwater video. Water depth was not recorded, but the colours are probably distorted towards the blue through attenuation. The specimen had been the subject of attention, and the tentacles are probably contracted and contorted: in the related *C. palmatus*, in undisturbed individuals the tentacles stream out straight and parallel with one another and are more attenuate. A-B, side views at (A) and near (B) end of bell contraction during swimming; note fully distended velarium, the round profile of the bell, the shape of the compound pedalium with the outer section supporting a single, puny, unpaired tentacle; the pale rhopalar discs between the pedalium bases; the transparent, thin jelly in the rhopalar radii; and the banded tentacles. C, aboral ('top') view; note somewhat square section with thicker jelly at the corners, and the prominent outward projection of the outer branch of the pedalium. D, oral view; note transparency of the thin jelly in the rhopalar radius, visible through the wide velarial aperture; and the pedalia.

enabling the rhopalial photoreceptors to better detect light. In this species the unpaired outermost tentacle on each compound pedalium is puny in comparison with the others, being much shorter and narrower, whereas in *C. fleckeri* it is approximately equal in length and width to the other tentacles, and in *C. quadrumanus* it is between the two in relative size. Finally, in the new species the folds in the inter-rhopalar muscle-fields are much deeper than in other chirodropids (Fig. 4).

CONCLUSIONS

Little can be said about the so-far unique occurrence of this species since there is little indication of how it got to the collection locality. The species should be regarded by those handling

it as possibly very dangerous to Man, like other large chirodropids, until proved otherwise.

ACKNOWLEDGEMENTS

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